SPECIFICATION

ELECTRICAL DEVICE FOR INTERCONNECTING TWO PRINTED CIRCUIT BOARDS AT A LARGE DISTANCE

BACKGROUND OF THE INVENTION

Cross Reference to Related Applications

[0001] This patent application relates to an earlier filed co-pending U.S. patent application Serial No. 10/159,459, entitled "ELECTRICAL SYSTEM HAVING MEANS FOR ACCOMMODATING VARIOUS DISTANCES BETWEEN PC BOARDS THEREOF MOUNTING THE MEANS", filed on May 31, 2002 and assigned to the same assignee as the present invention.

1. Field of the Invention

[0002] The present invention relates to an electrical device for interconnecting two printed circuit boards (PCBs), and particularly to an electrical device for interconnecting two parallel PCBs at a large distance.

2. Description of Related Art

[0003] Board mountable connectors are widely used to establish electrical connections between two separated PCBs. Usually, there are two connectors, a plug connector and a receptacle connector, respectively mounted onto the PCBs and engagable with each other. However, the conventional method using plug and receptacle connectors has been limited. In some situations, PCBs may be positioned within an electrical system at a large distance, where the plug and receptacle connectors have to span the large distance and thus would be fairly tall. A tall connector has greater tolerances associated with it and may undesirably

expand and contract greatly over temperature variations. This may possibly cause unreliable electrical coupling between two PCBs. Furthermore, the large distance between the PCBs would also require the plug and receptacle connectors to be fairly high and therefore expensive and difficult to manufacture.

[0004] One solution to the above issue is to provide two identical board mountable connectors respectively mounted on the two PCBs, and an extender engagable with the board mountable connectors. The extender includes an insulative housing, being generally "H"-shaped, and a plurality of conductive contacts received in passageways defined in the housing. When an extender is needed for a high stack height application, the contacts are usually long. This results in difficulties of inserting the contacts into the passageways of the housing without damage.

[0005] Another solution to the above issue is to provide an expensive cable assembly with two connectors at opposite ends to respectively connect with two PCBs. However, with electronic signal speeds currently in the gigahertz range and still increasing, deleterious transmission line effects have become more prevalent. The electrical connection of two PCBs by way of wire cables and connectors, often results in relatively long transmission lines between the two boards, allowing unwanted signal loss to exist. To mitigate these effects, shorter transmission lines between the two PCBs are advantageous.

[0006] Accordingly, there is a need for providing an effective and economical solution for the requirement of a high stack height application. To that end, the use of some kind of cost-effective PCB interconnection device, which ensures reliable electrical connection between two PCBs and provides an easy assembly, is desirable.

SUMMARY OF THE INVENTION

[0007] Accordingly, one object of the present invention is to provide a cost-effective, easily-assembled electrical device for interconnecting two PCBs at a large distance.

[0008] Another object of the present invention is to provide an electrical device reliably interconnecting two PCBs by reducing signal line lengths between the two PCBs.

[0009] A further object of the present invention is to provide an extender having a circuit board for facilitating assembly of the extender.

[0010] In order to achieve the objects set forth, an electrical device for interconnecting two PCBs at a large distance in accordance with the present invention comprises a first and a second connectors for being respectively mounted on the two PCBs, and an extender located between and electrically connected with the first and second connectors. The extender comprises a frame for being fixed to one PCB, and two circuit boards attached to the frame and connecting with the first and second connectors at opposite ends thereof. Each circuit board has signal and ground traces on opposite sides thereof to connect with corresponding signal and ground contacts of the first and second connectors.

[0011] Other objects, advantages and novel features of the invention will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] FIG. 1 is an exploded, perspective view of an electrical device in accordance with the present invention and two PCBs to be connected thereto;

[0013] FIG. 2 is an assembled view of FIG. 1;

[0014] FIG. 3 is a cross-sectional view taken along line 3-3 of FIG. 2;

[0015] FIG. 4 is a cross-sectional view of either connector shown in FIG. 1;

[0016] FIG. 5 is a perspective view of an extender of the electrical device of the present invention;

[0017] FIG. 6 is a view similar to FIG. 4, but showing an opposite of the extender;

[0018] FIG. 7 is a top, planar view of the extender;

[0019] FIG. 8 is a bottom, planar view of the extender; and

[0020] FIG. 9 is a side view of the extender.

DETAILED DESCRIPTION OF THE INVENTION

[0021] Reference will now be made to the drawing figures to describe the present invention in detail.

[0022] Referring to FIGS. 1-3, an electrical device 1 for interconnecting two PCBs 2, 3 at a large distance in accordance with the present invention comprises a first and a second connectors 4, 5 for being respectively mounted on the two PCBs 2, 3, and an extender 6 located between and interconnected with the first and second connectors 4, 5. The extender 6 comprises a frame 7 for being fixed to the PCB 3, and two circuit boards 8, 9 attached to the frame 7 and connecting with the first and second connectors 4, 5 at opposite ends thereof.

[0023] The first and second connectors 4, 5 are preferably identical in this invention. Also referring to FIG. 4, each connector 4 (5) includes an insulative housing 40 (50), a plurality of signal contacts 41 (51) and a plurality of ground

contacts 42 (52). The insulative housing 40 (50) defines a plurality of passageways 400 (500) aligned in four rows in a longitudinal direction thereof, and two longitudinal slots 401 (501) each communicating with two corresponding rows of the passageways 400 (500). Two rows of retaining ribs 402 (502) are respectively provided on opposite sides of each slot 401 (501) proximate to a mating surface 403 (503) of the insulative housing 40 (50). Each retaining rib 402 (502) bears against a tip of a corresponding signal contact 41 (51) or ground contact 42 (52) for preloading purposes. The insulative housing 40 (50) further provides a plurality of stand-offs 404 (504) adjacent to a board mounting surface 405 (505) thereof and a polarization peg 406 (506) at one end thereof for being inserted into a corresponding through hole 20 (30) of the PCB 2 (3). A pair of grooves 407 (507) is defined at opposite ends of the insulative housing 40 (50) for polarization purposes.

[0024] The signal contacts 41 (51) are received in two outer rows of the passageways 400 (500), and the ground contacts 42 (52) are received in two inner rows of the passageways 400 (500). Each signal contact 41 (51) includes a contact portion 411 (511) connecting with the tip 410 (510) and projecting into a corresponding slot 401 (501), a retention portion 412 (512), and a surface mount portion 413 (513) extending beyond the board mounting surface 405 (505) of the insulative housing 40 (50) for being soldered to a corresponding solder pad 21 (31) of the PCB 2 (3). Each ground contact 42 (52) similarly includes a contact portion 421 (521) connecting with the tip 420 (520) and projecting into a corresponding slot 401 (501), a retention portion 422 (522), and a tail portion 423 (523) extending beyond the board mounting surface 405 (505) of the insulative housing 40 (50). The tail portions 423 (523) of the two rows of ground contacts 42 (52) in a same cross-section of the housing 40 (50) abut against each other for being inserted into a same plated through hole 22 (32) of the PCB 2 (3).

[0025] The detailed structure of the extender 6 is shown in FIGS. 1 and 5-9. The frame 7 of the extender 6 has a body portion 70 and two side portions 71. The body portion 70 provides a plurality of through holes 700 and two locating pegs 701 each having opposite end portions of different size. Each side portion 71 of the frame 7 has two substantially identical receiving sections 710 at opposite ends thereof. The pair of receiving sections 710 at the same end of the frame 7 is arranged in such a manner that a receiving port is defined therebetween for receiving a corresponding connector 4, 5 therein. A lead-in 712 is provided at the top of each receiving section 710 for guiding insertion of a corresponding connector 4, 5 into the receiving port. A protrusion 711 is provided in each receiving section 710 for engagement with a corresponding groove 407, 507 of the connector 4, 5. A pair of mounting legs 712 is provided at opposite sides of one receiving section 710 of each side portion 71. Each mounting leg 712 defines a hole 713 therein for allowing extension of a screw 72 therethrough into a corresponding hole 33 of the PCB 3, thereby securing the frame 7 to the PCB 3.

[0026] Each circuit board 8, 9 has a pair of end portions 80, 90 at opposite ends thereof and a pair of shoulders 81, 91 on opposite sides of each end portion 80, 90. A plurality of signal traces 82, 92 and ground traces 83, 93 is respectively provided on opposite sides of each circuit board 8, 9 to connect with corresponding signal contacts 41, 51 and ground contacts 42, 52 of the first and second connectors 4, 5. Each circuit board 8, 9 further defines a plurality of first holes 84, 94 aligned with corresponding through holes 700 of the frame 7 for extension of a corresponding number of bolts 73 therethrough to engage with a corresponding number of bolts 74. Two second holes 85, 95 of different size are further defined in each circuit board 8, 9 for receiving corresponding end portions of the two locating pegs 701 of the frame 7. The two circuit boards 8, 9 are securely attached to the body portion 70 of the frame 7 by means of the bolt-nut engagement and also by the engagement between the locating pegs 701 and the second holes 701. After

attachment, the signal traces 82, 92 of the two circuit boards 8, 9 are outwardly exposed, the shoulders 81, 91 abut against the bottoms of corresponding receiving sections 710 of the frame 7, and the end portions 80, 90 extend into corresponding receiving ports of the frame 7 for allowing mating of the respective signal traces 82, 92 and ground traces 83, 93 thereon with corresponding signal contacts 41, 51 and ground contacts 42, 52 of the first and second connectors 4, 5.

[0027] The electrical device 1 of the present invention provides an effective and economical solution for the requirement of a high stack height application. By providing an extender configured by a frame and two circuit boards, the assembly of the electrical device is significantly facilitated. The provision of the circuit board 8, 9 instead of a conventional cable assembly ensures a reliable electrical interconnection between the two PCBs 2, 3 since signal line lengths between the two PCBs 2, 3 are reduced and thus deleterious transmission line effects are eliminated. To further ensure a reliable electrical interconnection between the two PCBs 2, 3, a metal shield may be attached to the electrical device 1 of the present invention to reduce electro-magnetic interference.

[0028] It should be understood that, although two circuit boards 8, 9 are employed in the preferred embodiment of this invention, one circuit board instead of two may also be applied to achieve the same inventive objects. In such a situation, the connectors 4, 5 should be modified to include only two rows of contacts instead of four.

[0029] It is to be understood, however, that even though numerous characteristics and advantages of the present invention have been set forth in the foregoing description, together with details of the structure and function of the invention, the disclosure is illustrative only, and changes may be made in detail, especially in matters of shape, size, and arrangement of parts within the principles

of the invention to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.